

Natural growth regimes for hatchery-reared steelhead to reduce residualism and negative ecological interactions

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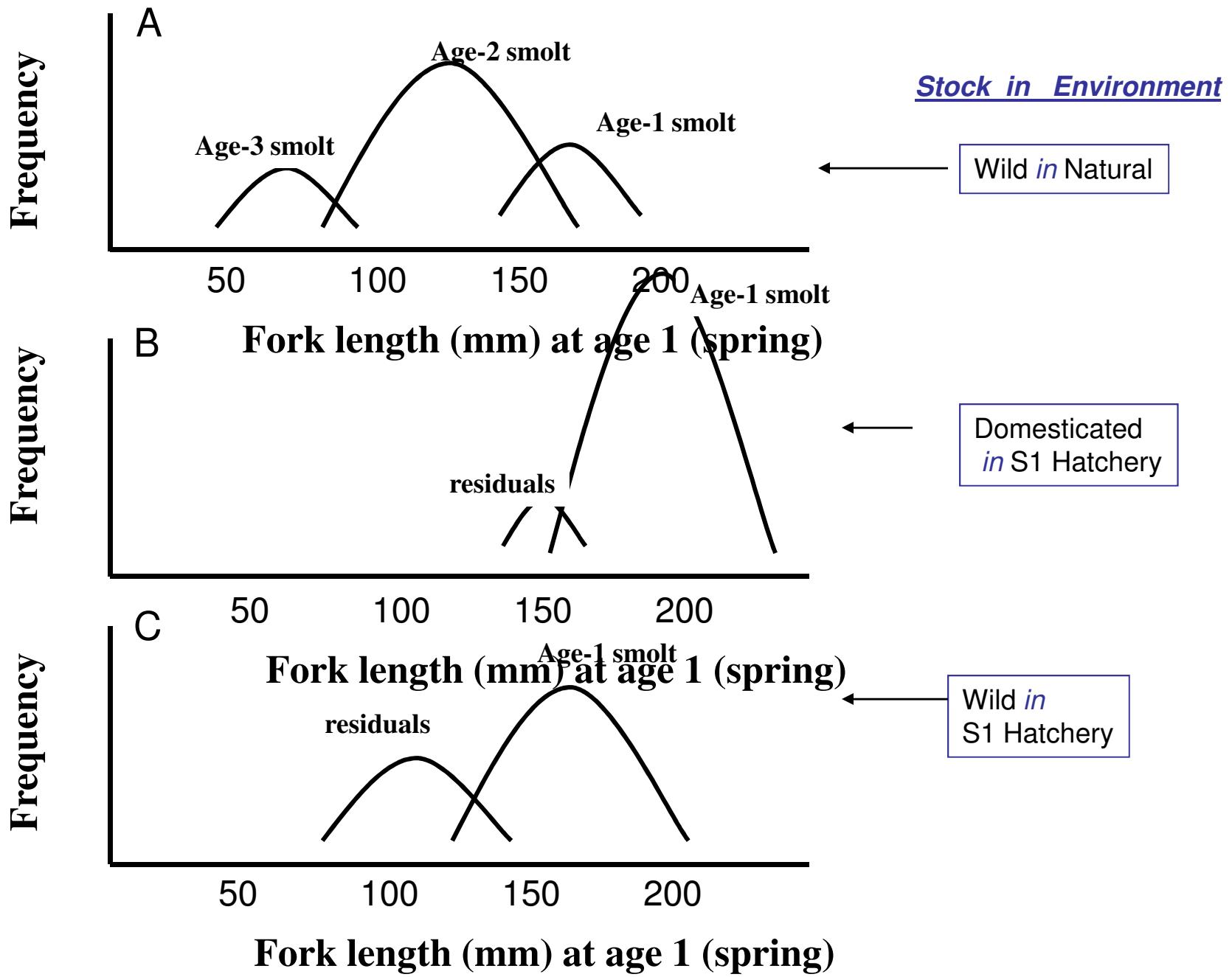
1/ NOAA Fisheries, Northwest Fisheries Science Center

2/ US Fish and Wildlife Service, Mid-Columbia River Fishery Resource Office

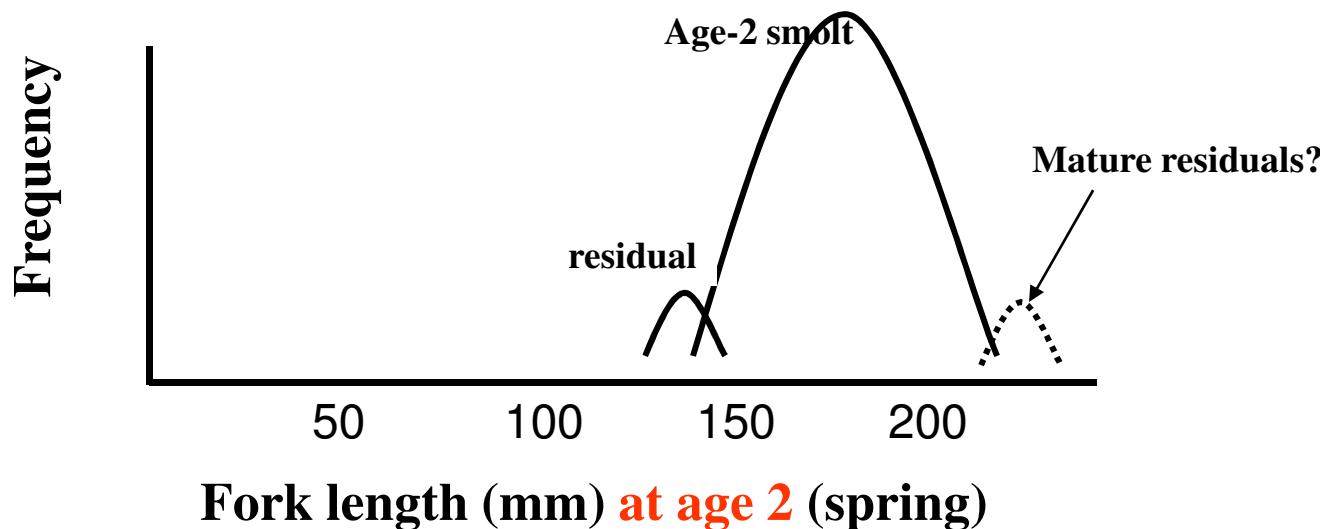
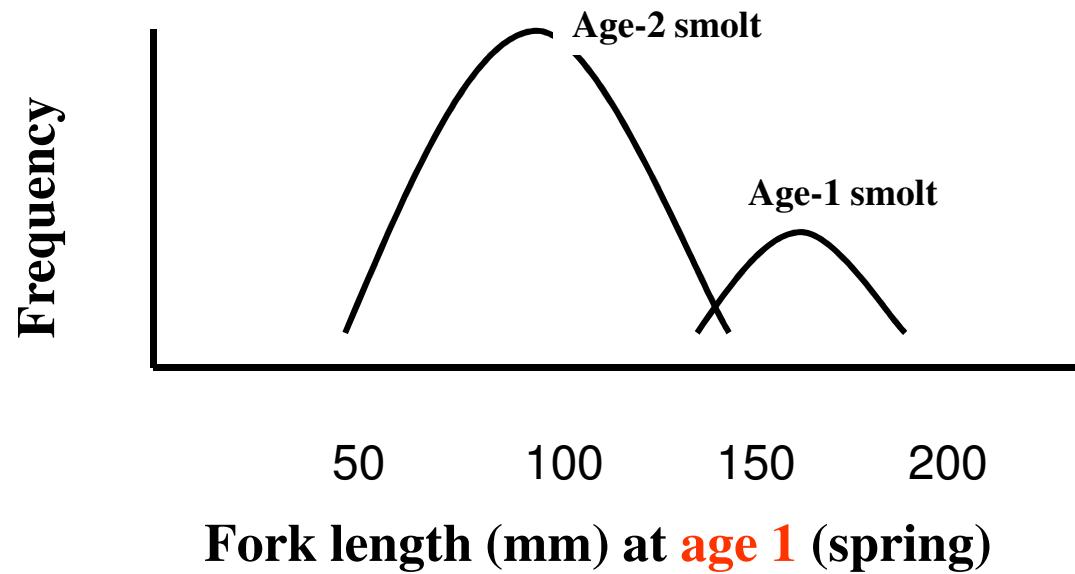
3/ US Fish and Wildlife Service, Winthrop National Fish Hatchery



Size-at-age and smoltification



Model for integrated hatchery programs



Ecological interactions and residualism

- **Causes of residualism**

- Early male maturity (*Sharpe et al. 2007*)

- Small body size (*Sharpe et al. 2007, Viola and Schuck 1995*)

- Incomplete smoltification (*Kennedy et al. 2007, Hill et al. 2006*)

- Broodstock choice (domesticated vs wild)

- **Potential Consequences**

- Size-biased and density-dependent interference competition (*McMichael et al. 2000*)

- Disruptive breeding interactions (Atlantic salmon: *Fleming et al. 1998*)

- Predation on juvenile salmonids (*Kostow 2008; Naman and Sharpe*)

Methods to reduce residualism

- Volitional release and retention of non-migrants (Viola and Schuck 1995; Gale et al. 2009)
- Growth modulation to improve age-1 smoltification (Sharpe et al. 2007)
 - Size sort in the fall prior to smoltification
 - ‘push’ growth of smaller fish
- Hypothesis: Growth modulation and age-2 smolt rearing will improve migratory behavior, survival, and reduce residualism

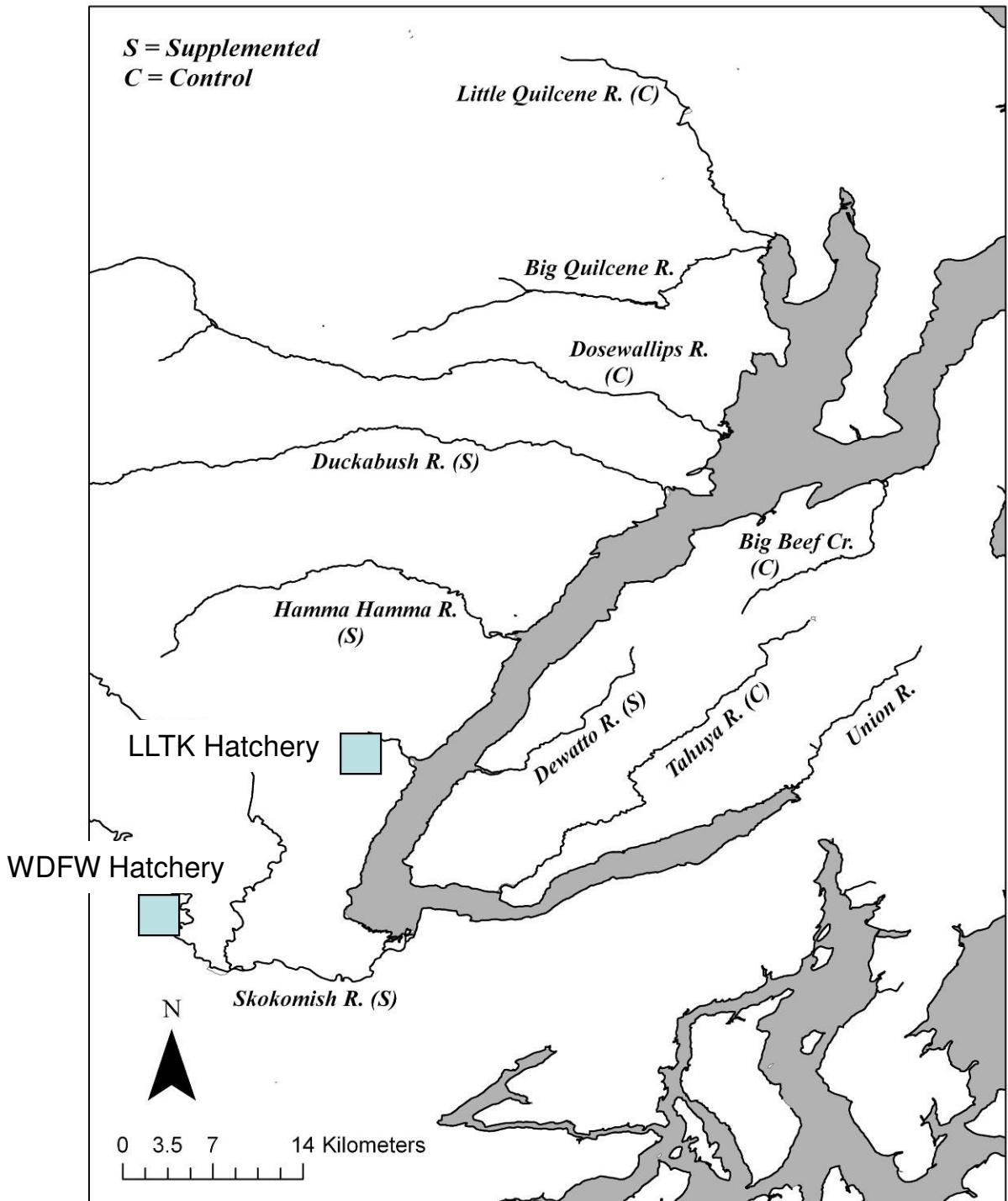
Hood Canal Steelhead



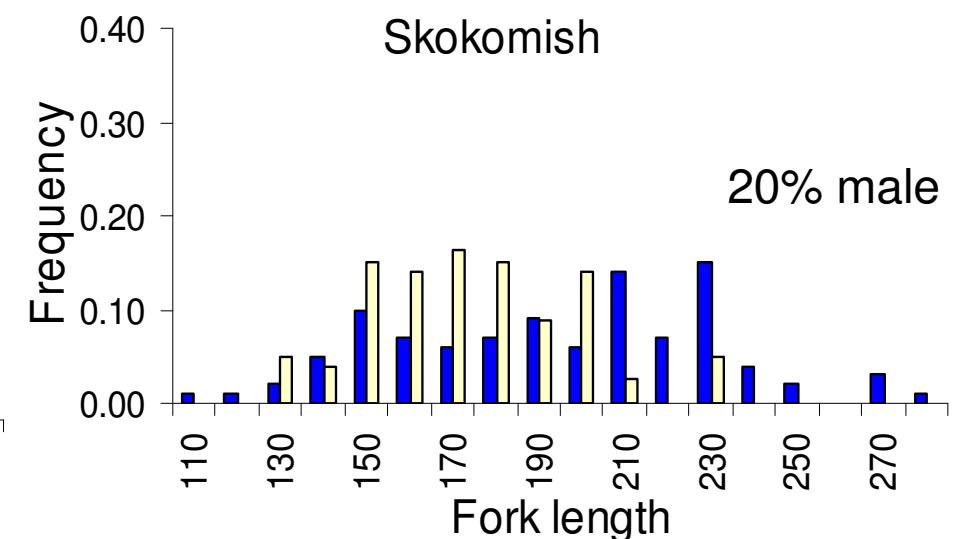
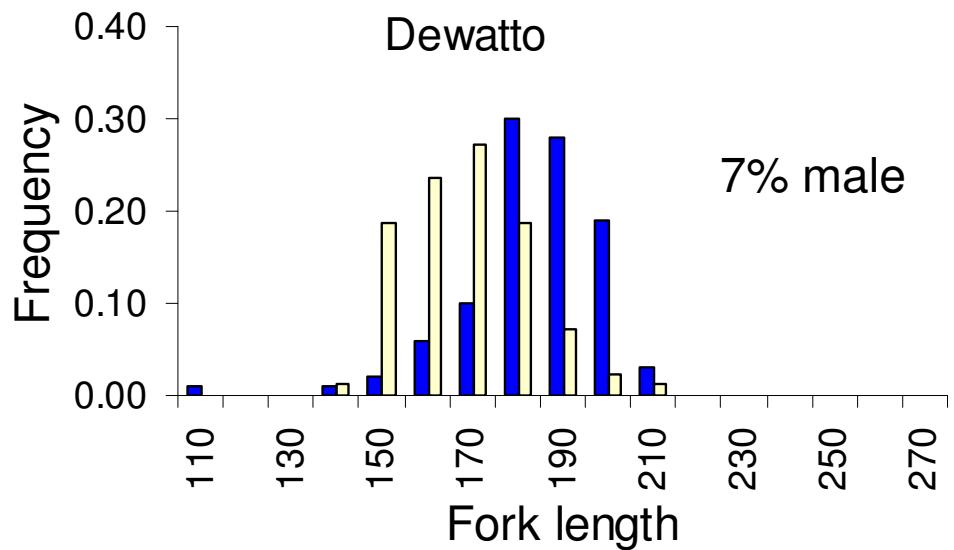
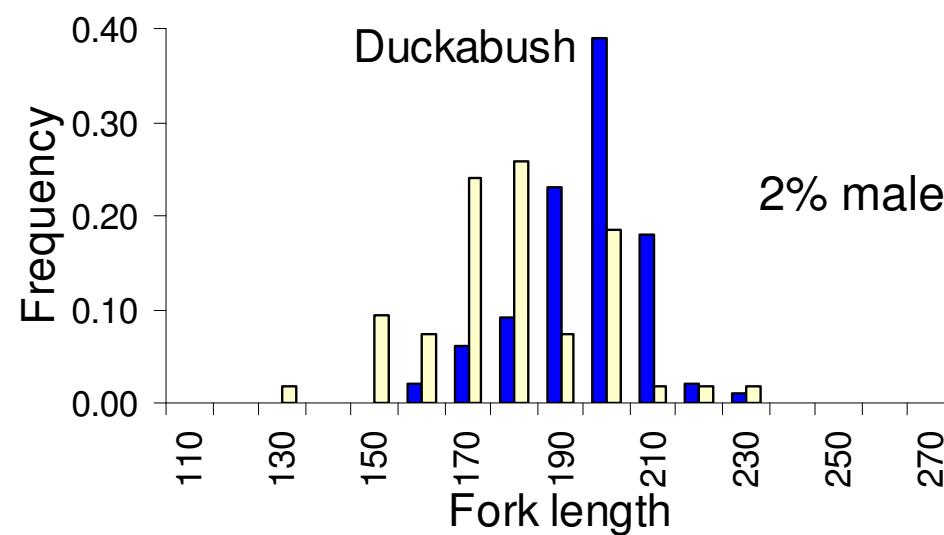
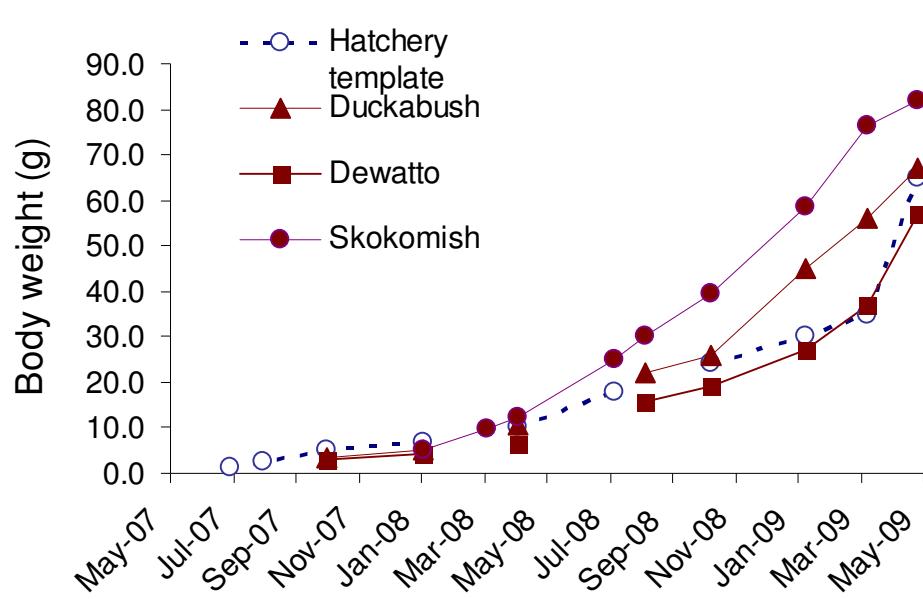
Hydraulic redd sampling



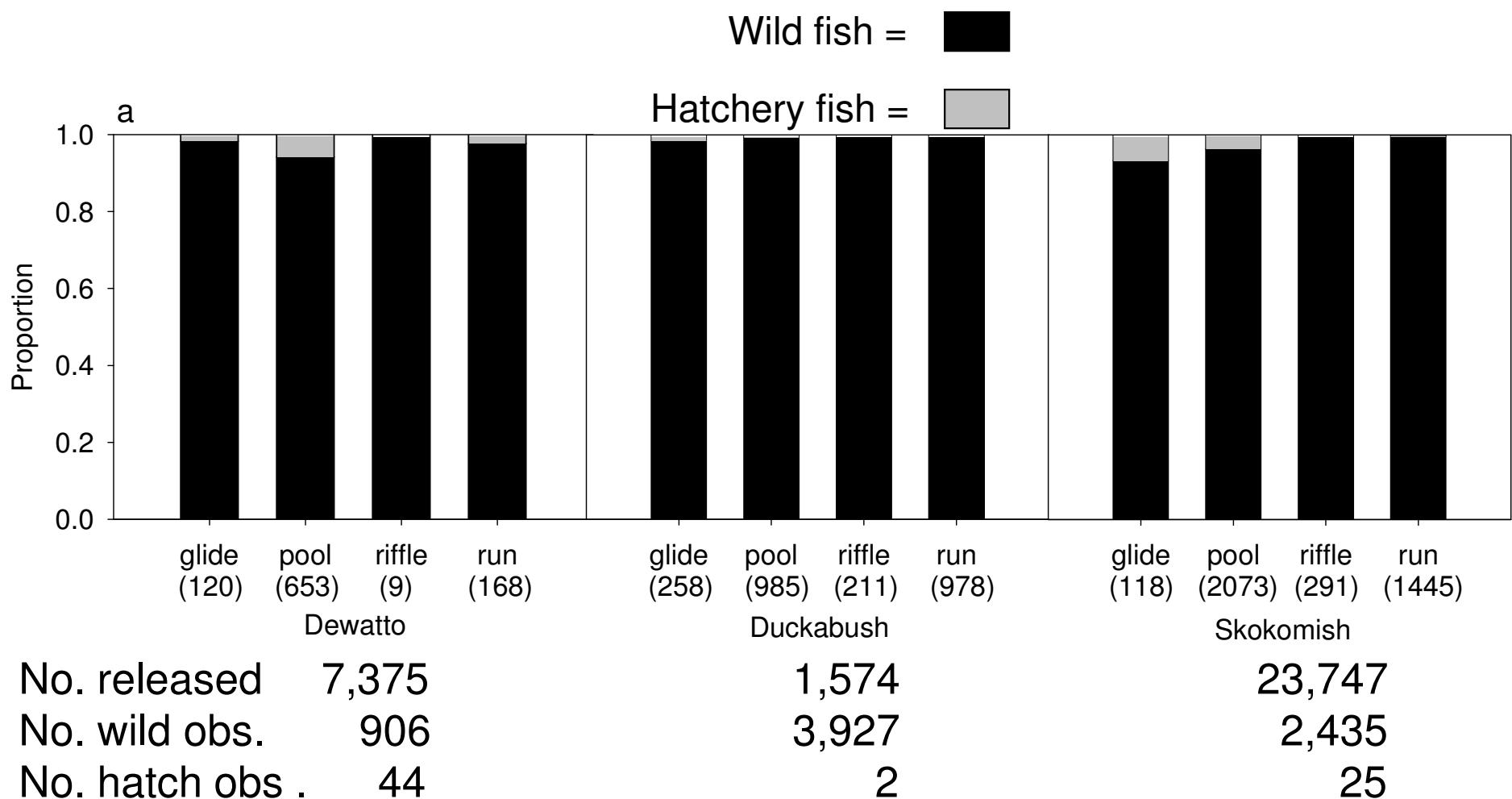
Age-2 smolt rearing



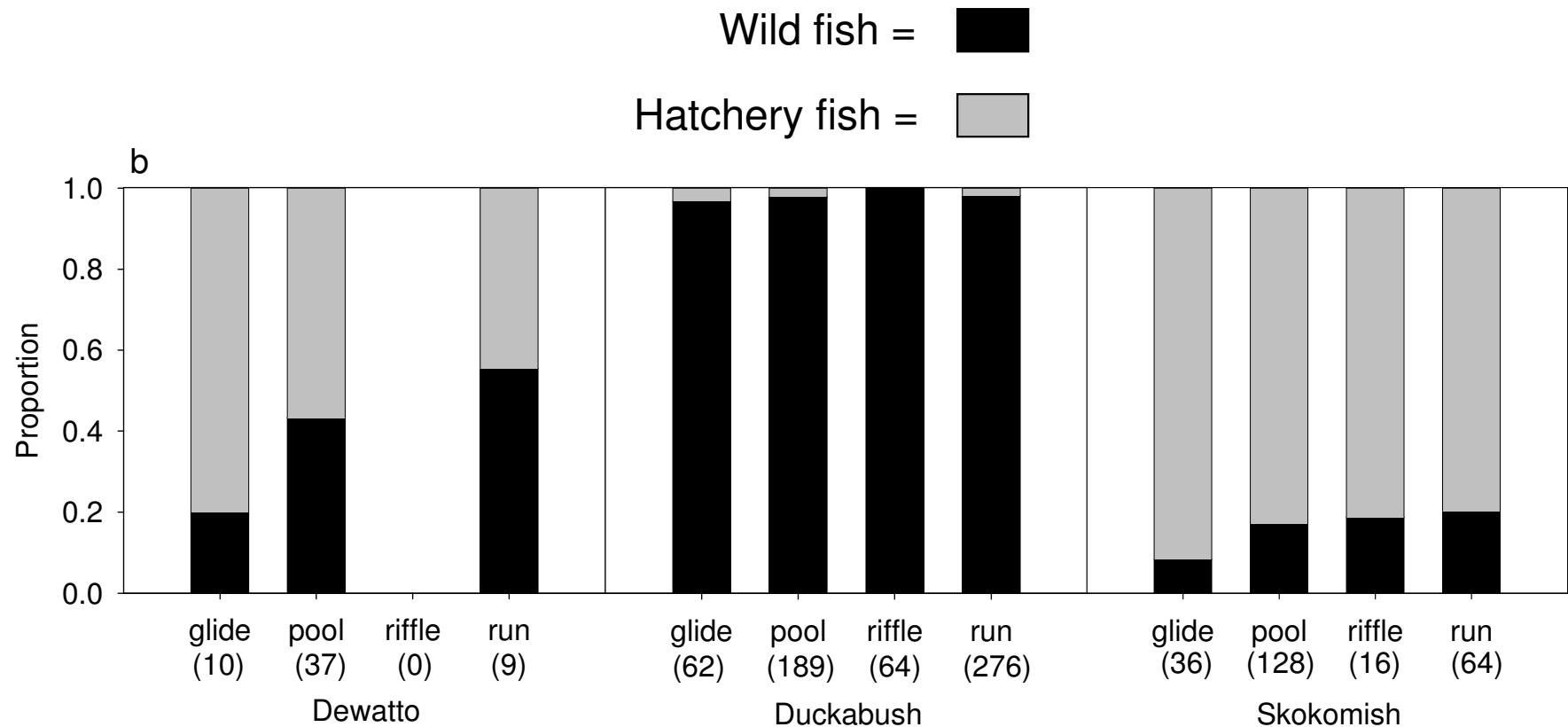
Hood Canal steelhead age-2 smolt size



Hood Canal steelhead residuals (mid-summer: TL 100-200 mm)

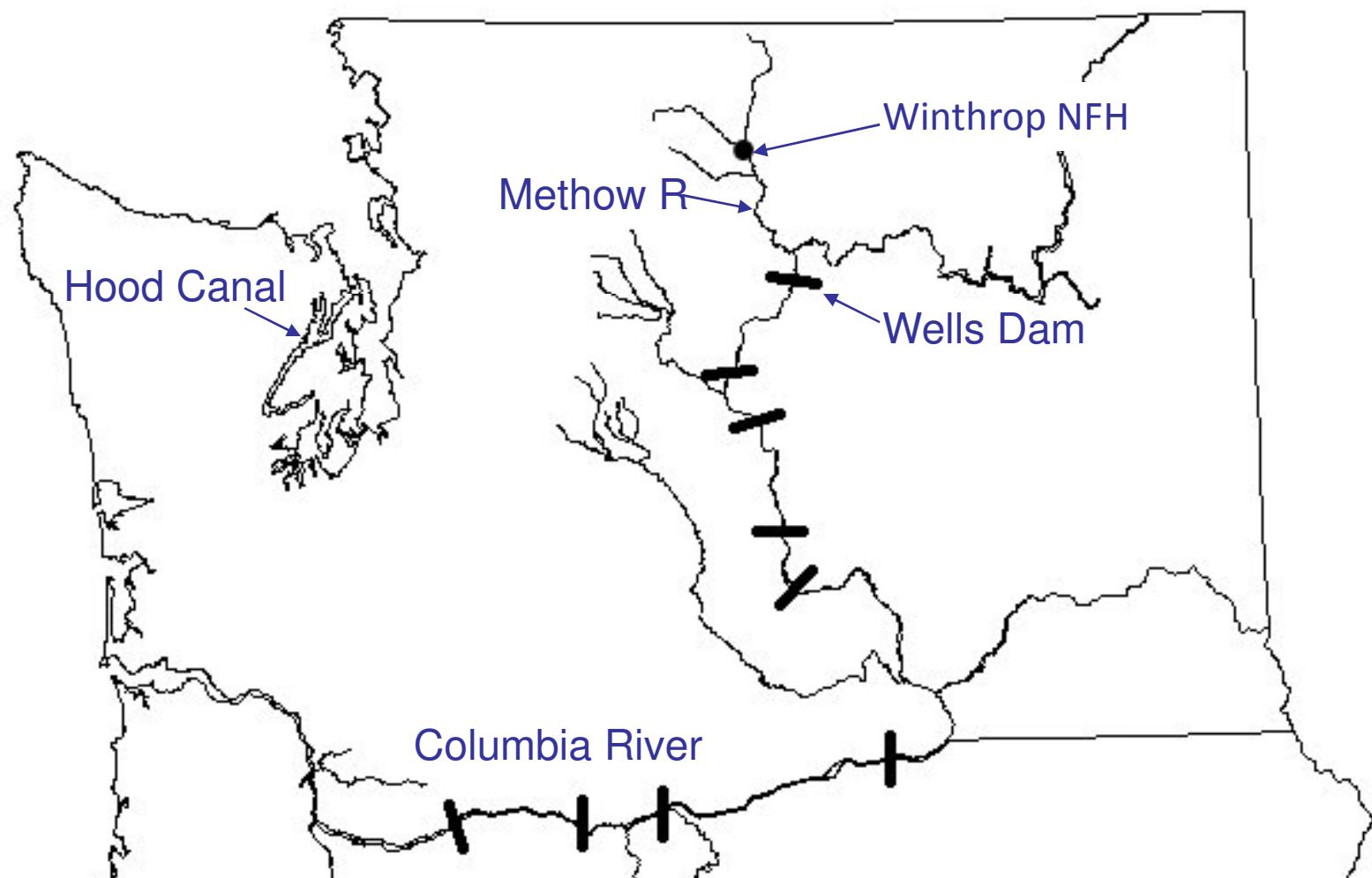


Hood Canal steelhead residuals (mid-summer: TL > 200 mm)



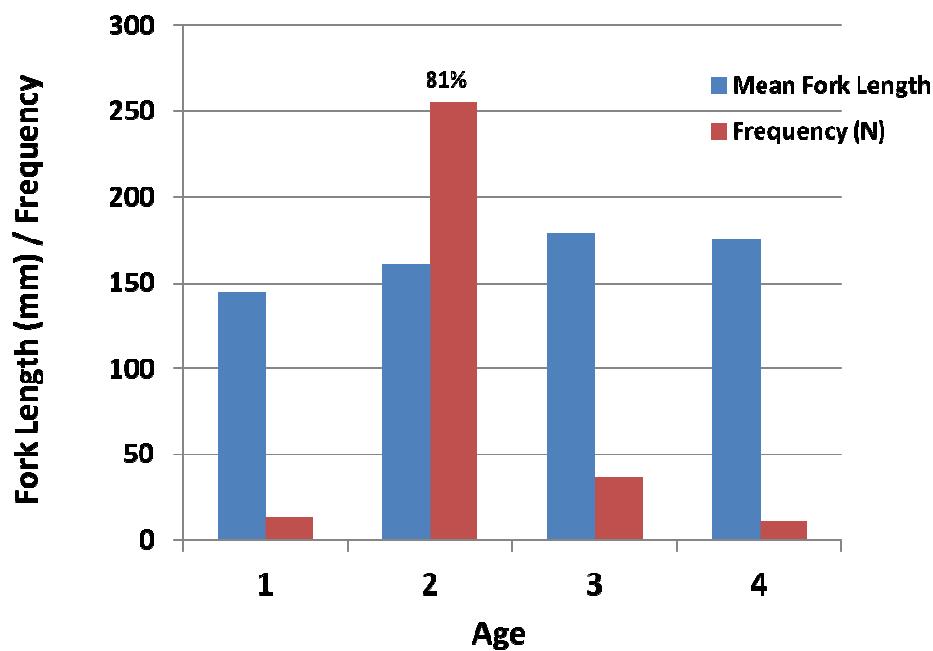
No. released	7,375	1,574	23,747
No. wild obs	56	591	244
No. H obs	33	11	203

Methow River summer steelhead



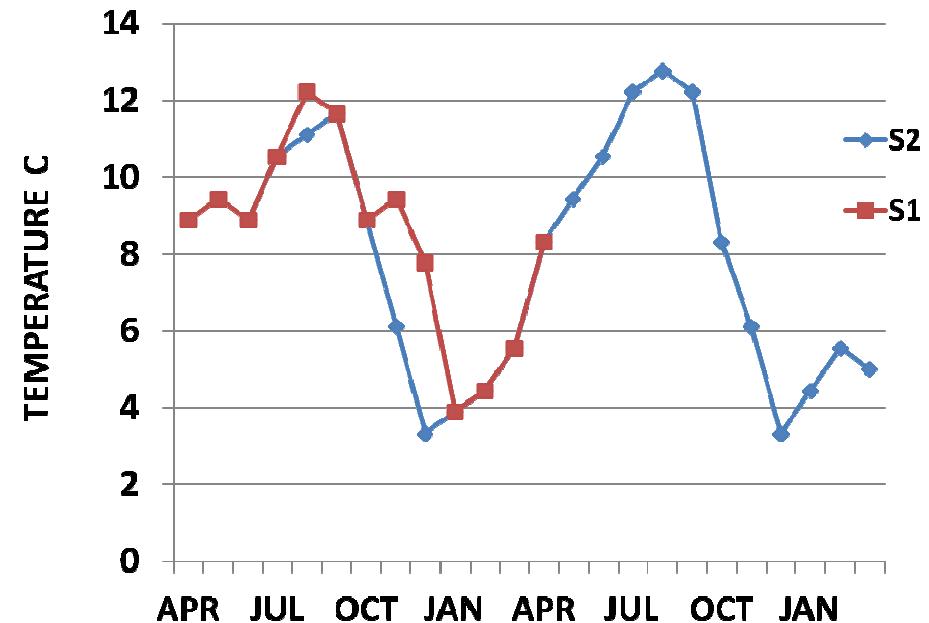
Growth Modulation

Methow Wild Steelhead – WDFW screw trap 2009

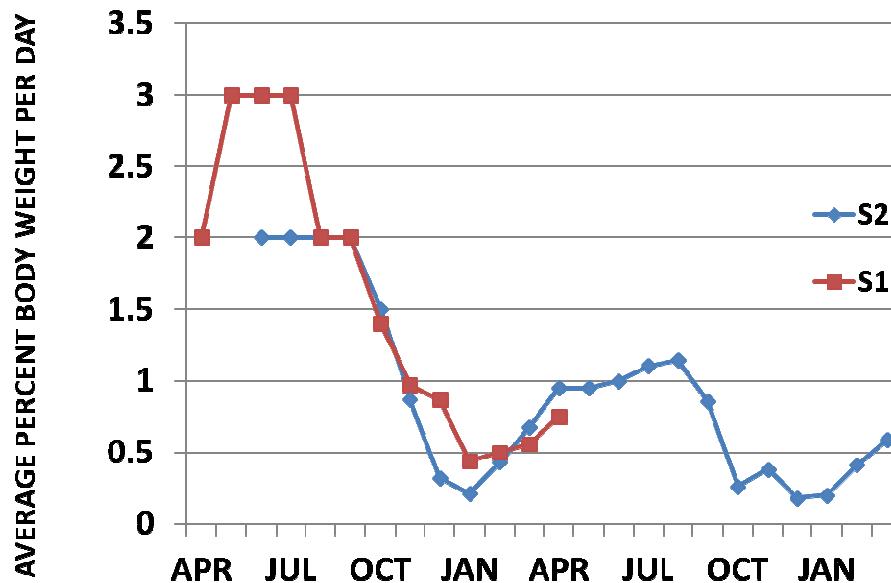


Source: Charlie Snow, WDFW, unpublished data

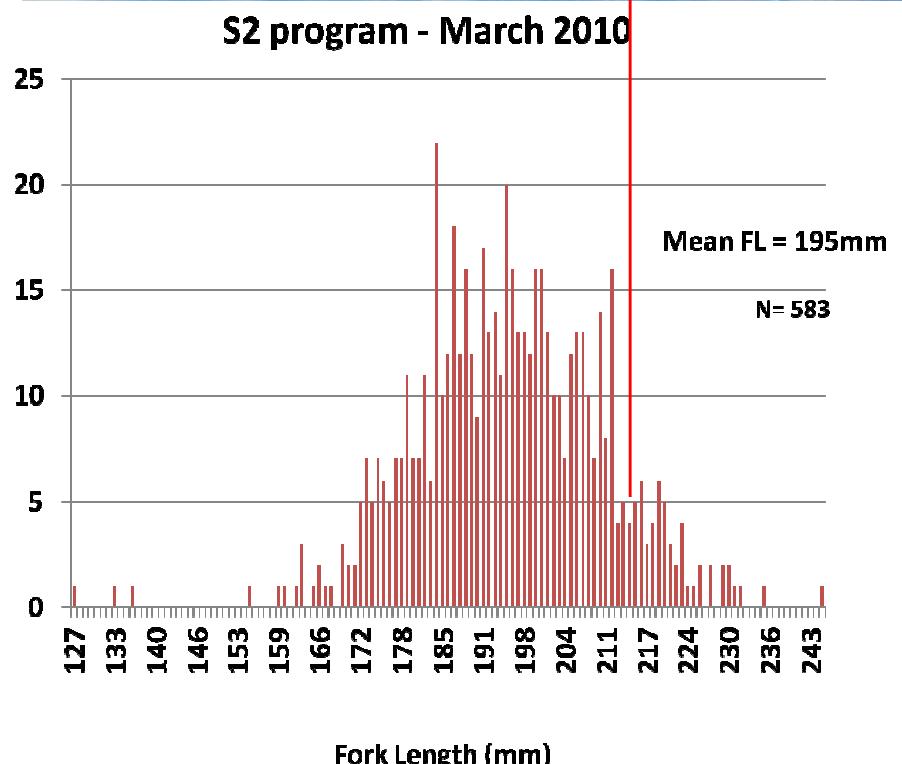
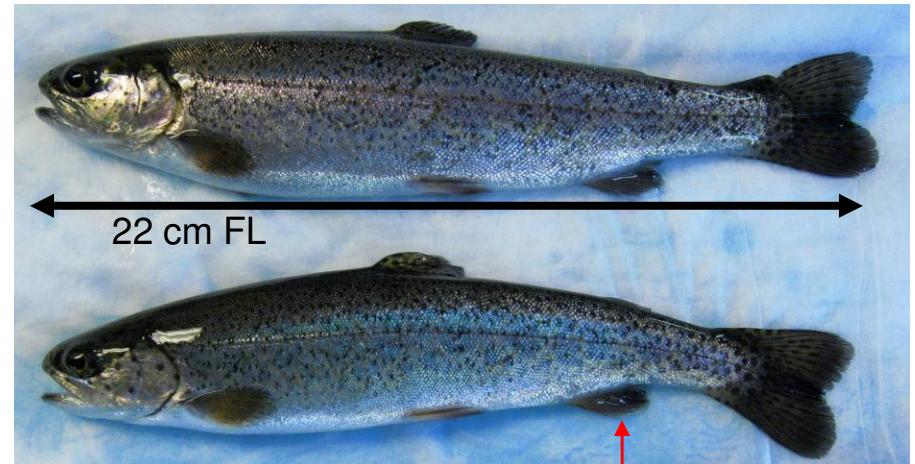
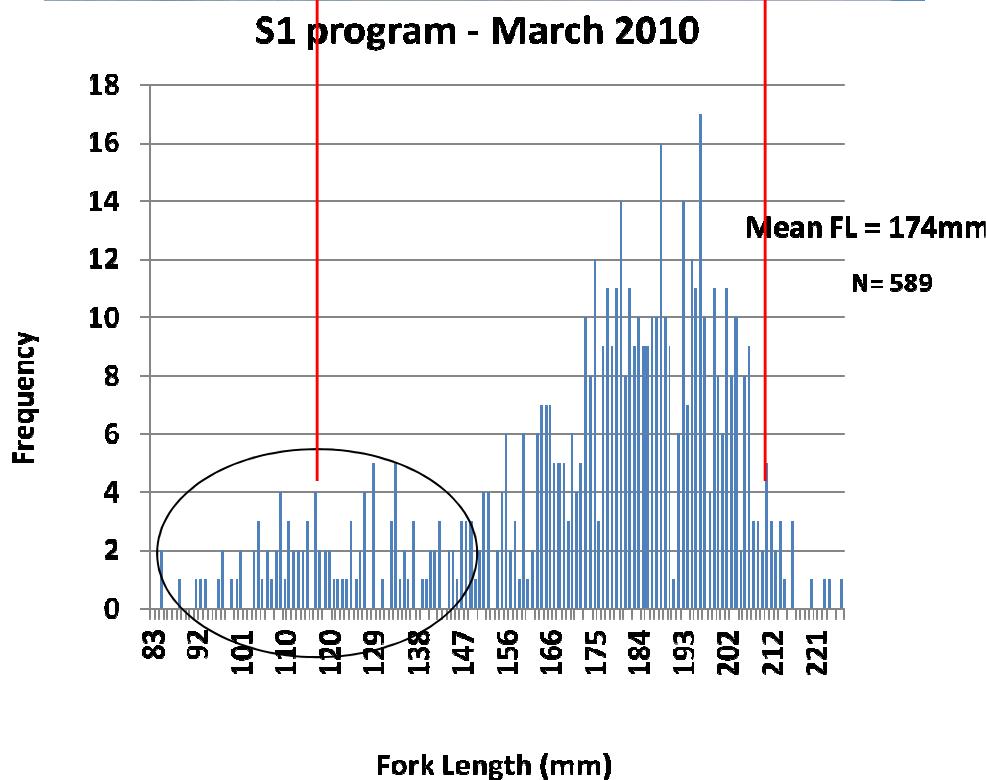
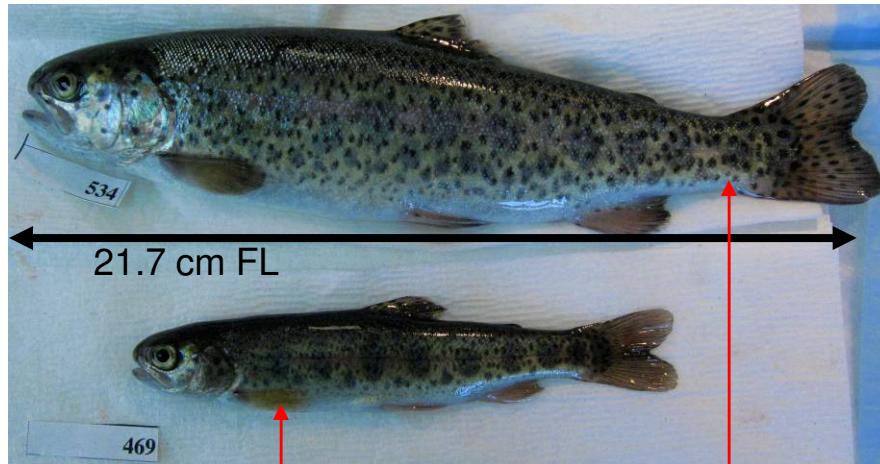
April '08 - March '10



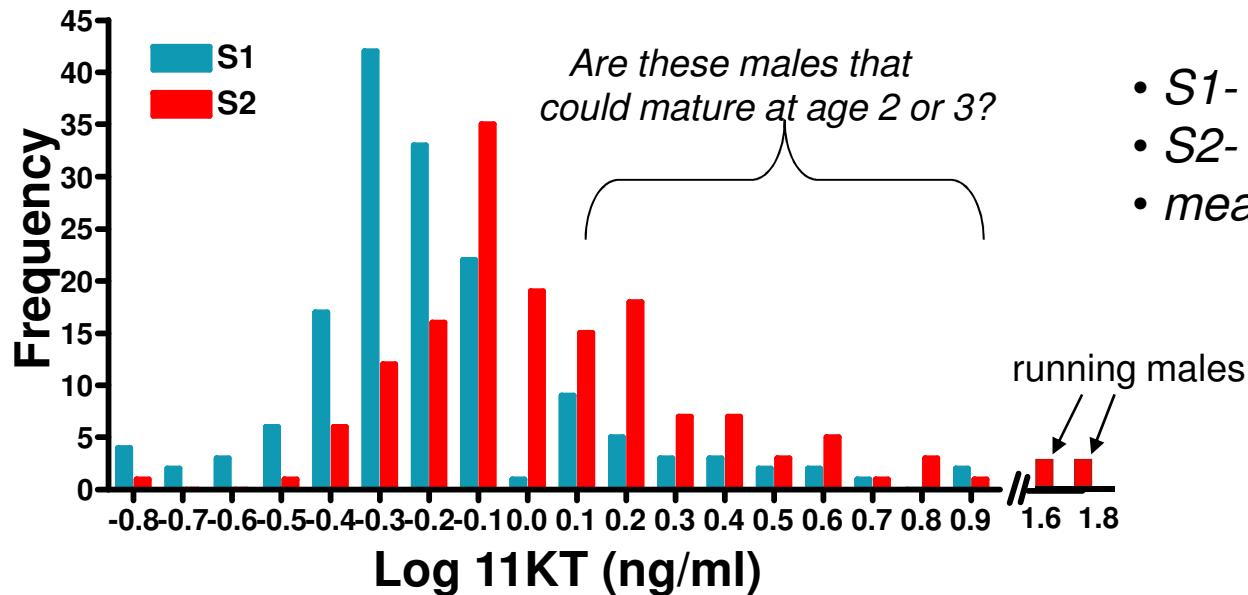
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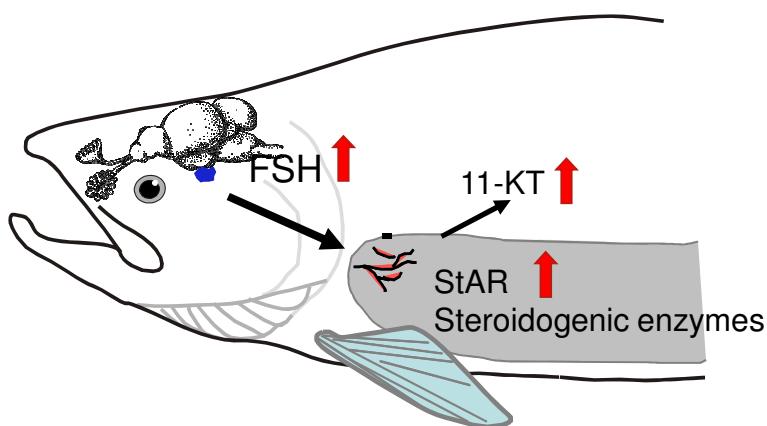
Size frequency of S1 and S2 smolts



Early male maturity?



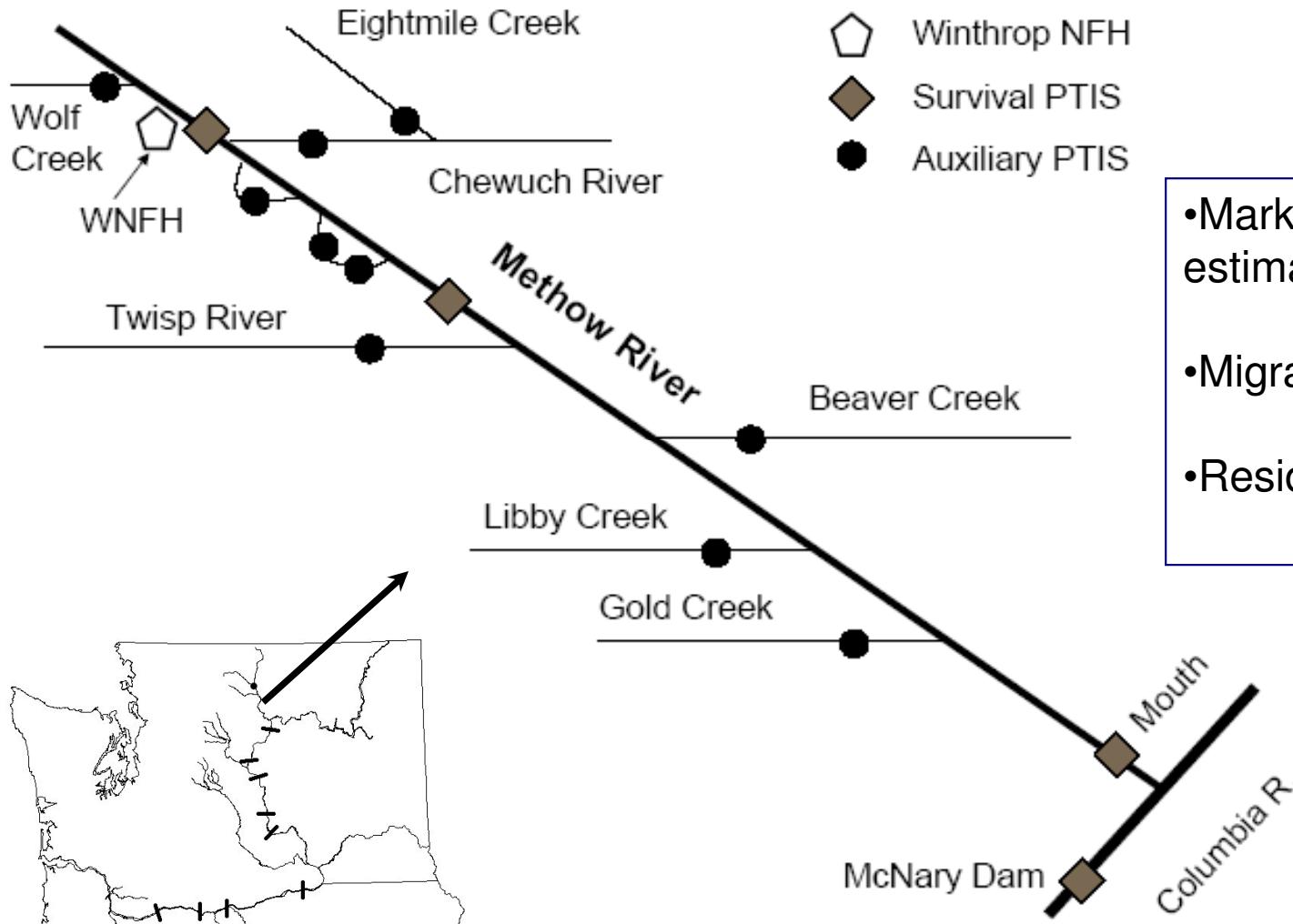
- S1- 0.0% mature males
- S2- 3.8% of males were mature
- mean KT levels higher in S2



Do plasma levels of 11KT, or mRNAs for pituitary FSH or testis StAR predict male maturation?

- at age-3 for S2 smolts
- at age-2 for S1 smolts

Migration monitoring



- Mark-recapture survival estimates
- Migratory behavior
- Residual behavior

Source (P. Connelly, USGS)

Final thoughts

- S2 smolt programs require
 - Careful planning, execution, and evaluation
 - Suitable rearing environment (space + temps)
- Optimal rearing strategy depends on
 - Program goals
 - Broodstock characteristics
 - Water supply
 - Cost-benefit (\$ and ecological)

Acknowledgements

- Hood Canal Steelhead Project partners
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- BOR (Michael Newsome)
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